

Prokaryotes in deep marine subsurface sediments: Phylogenetic diversity of a global extreme habitat

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Marine sediments cover more than 2/3 of Earth. Microbial cells and prokaryotic activity appear to be widespread in those sediments. Intact cells and intact membrane lipids provide evidence of prokaryotic populations in sediments as deep as 800 meters below the seafloor. The prokaryotes of subseafloor sediments have been estimated to constitute 1/2 to 5/6 of Earth's prokaryotic biomass and 1/10 to 1/3 of Earth's total living biomass. These prokaryotic populations tolerate carbon substrate and electron acceptor limitation in this extreme environment.

To determine the phylogenetic composition and diversity of subsurface prokaryotes, subsurface sediment cores were obtained through the Ocean Drilling Program (ODP Leg 201) at Site 1225 in the Eastern Equatorial Pacific (3760 m depth), and at Site 1231 in the Peru Basin (4813 m depth). These sediments are characterized by low organic carbon content and low anaerobic respiration rates. The 16S rRNA gene profiles of these and other subsurface sediments in different marine regions indicate general trends of subsurface microbial community composition.

1) Several phylum-level archaeal and bacterial lineages have cosmopolitan distribution patterns across geochemically distinct and geographically distant subsurface habitats. 2) These repeatedly occurring lineages create a "signature" microbial community of subsurface marine sediments that is taxonomically and systematically distinct from surface microbiota. 3) Closely related phylotypes are found in hydrothermal as well as in non-hydrothermal subsurface habitats, possibly due to subsurface fluid flow and hydrothermal circulation. 4) Cosmopolitan seawater archaeal lineages (i.e., Marine Group I) show distinct clusters of subsurface representatives, indicating the evolution of subsurface specialists.